1) $\frac{20x^{-3}y^{5}}{4x^{-2}y^{4}} = \boxed{\frac{5y}{x}}$ $\frac{20x^{2}y^{5}}{4x^{3}y^{4}}$

2) $(2c^{\frac{1}{2}}d)(c^{\frac{3}{2}}d^{-1}) = 2c^{\frac{4}{2}} = \boxed{2c^{2}}$

3) $(12a^{1/5})^{0} = \boxed{1}$ Raised to the zero power = 1

4) $\frac{(2a^{2}b^{4})^{2}}{2a^{3}b^{-5}} = \frac{(2a^{2}b^{4})(2a^{2}b^{4})}{2a^{3}b^{-5}} = \frac{4a^{4}b^{8}}{2a^{3}b^{-5}} = \boxed{2ab^{13}}$

5) $\sqrt{36x^{7}y^{11}}$

$\sqrt{36x^{6}y^{10}}\ \sqrt{xy}$

$\boxed{6x^{3}y^{5}\sqrt{xy}}$

6) $(-2)\sqrt[3]{24x^{8}y^{10}z^{18}}$

$\sqrt[3]{8x^{6}y^{9}z^{18}}\ \sqrt[3]{3x^{2}y}$

$-2 \cdot 2x^{2}y^{3}z^{6}\ \sqrt[3]{3x^{2}y}$

$\boxed{-4x^{2}y^{3}z^{6}\sqrt[3]{3x^{2}y}}$

7) $(5c^{-3}d^{-6}e^{2})(2c^{-4}d^{-2}e^{-2}) = 10c^{-7}d^{-8} = \boxed{\frac{10}{c^{7}d^{8}}}$

8) $(3a^{2}b^{4})^{3}(2a^{-4}b)^{-1} =$

$(27a^{6}b^{12})(2^{-1}a^{4}b^{-1}) = \boxed{\frac{27a^{10}b^{11}}{2}}$

9) $\sqrt{90} + \sqrt{40}$

$\sqrt{9}\sqrt{10} + \sqrt{4}\sqrt{10}$

$3\sqrt{10} + 2\sqrt{10}$

$\boxed{5\sqrt{10}}$

10) $\sqrt{98} - 2\sqrt{18}$

$\sqrt{49}\sqrt{2} \quad \sqrt{9}\sqrt{2}$

$7\sqrt{2} \quad -2 \cdot 3\sqrt{2}$

$7\sqrt{2} - 6\sqrt{2} = \boxed{\sqrt{2}}$

11) $2\sqrt{5} \cdot \sqrt{15}$

$2\sqrt{75}$

$\sqrt{25}\sqrt{3}$

$2 \cdot 5\sqrt{3}$

$\boxed{10\sqrt{3}}$

12) $\frac{\cancel{6}^{1}\sqrt{60}^{20}}{\cancel{24}_{4}\sqrt{3}_{1}} = \frac{1\sqrt{20}}{4} \quad \frac{\sqrt{4}\sqrt{5}}{4}$

$\frac{\cancel{2}^{1}\sqrt{5}}{\cancel{4}_{2}} = \boxed{\frac{\sqrt{5}}{2}}$

13) $\sqrt{3}(2\sqrt{27} - \sqrt{6})$

$2\sqrt{81} - \sqrt{18}$

$2 \cdot 9 - \sqrt{9}\sqrt{2}$

$\boxed{18 - 3\sqrt{2}}$

14) $(2 + \sqrt{5})(3 - \sqrt{5})$

$6 - 2\sqrt{5} + 3\sqrt{5} - 5$

$\boxed{1 + \sqrt{5}}$

15) $\frac{3}{5}\sqrt{75a^4b^6c} - \frac{1}{2}\sqrt{192a^4b^6c}$

$\sqrt{25a^4b^6}\sqrt{3c} \quad \sqrt{64a^4b^6}\sqrt{3c}$

$\frac{3}{5} \cdot 5a^2b^3\sqrt{3c} \quad -\frac{1}{2} \cdot 8a^2b^3\sqrt{3c}$

$3a^2b^3\sqrt{3c} - 4a^2b^3\sqrt{3c}$

$\boxed{-1a^2b^3\sqrt{3c}}$

1, 8, 27, 64, 125 cubes

index is 3 so we need perfect cubes to "break out"

16) $18\sqrt[3]{32y^7} + 6\sqrt[3]{4y}$

$\sqrt[3]{8y^6}\ \sqrt[3]{4y}$

$18 \cdot 2y^2\ \sqrt[3]{4y}$

$36y^2\sqrt[3]{4y} + 6\sqrt[3]{4y}$

Not like terms because $36y^2$ and 6 are not like

$\boxed{36y^2\sqrt[3]{4y} + 6\sqrt[3]{4y}}$

17) $3\sqrt{4a^3} - 6\sqrt{9a^3}$

$\sqrt{4a^2}\sqrt{a}\quad \sqrt{9a^2}\sqrt{a}$

$3 \cdot 2a\sqrt{a} \quad -6 \cdot 3a\sqrt{a}$

$6a\sqrt{a} - 18a\sqrt{a}$

$\boxed{-12a\sqrt{a}}$

18) $3a^2b^3(4a^3b - 3a^2b^2 + 5ab^3)$

$\boxed{12a^5b^4 - 9a^4b^5 + 15a^3b^6}$

19) $(7y+2)(7y-2)$

$49y^2 - 14y + 14y - 4$

$\boxed{49y^2 - 4}$

20) $(7x-2)(5x+8)$

$35x^2 + 56x - 10x - 16$

$\boxed{35x^2 + 46x - 16}$

21)

| | $3x^2$ | $+x$ | $-4$ | |
|---|---|---|---|---|
| | $6x^3$ | $2x^2$ | $-8x$ | $2x$ |
| $6x^3$ | $-15x^2$ | $-5x$ | $+20$ | $-5$ |
| | $-13x^2$ | $-13x$ | $+20$ | |

$\boxed{6x^3 - 13x^2 - 13x + 20}$

22)

| | $2x^2$ | $-3x$ | $+4$ |
|---|---|---|---|
| $6x^4$ | $6x^4$ | $-9x^3$ | $+12x^2$ |
| $-5x^3$ | $+4x^3$ | $-6x^2$ | $+8x$ |
| $3x^2$ | $-2x^2$ | $+3x$ | $-4$ |
| $+2x$ | | | |
| $-1$ | | | |

$+4x^2$ $+11x$ $-4$

$6x^4-5x^3+4x^2+11x-4$

23) $\frac{\sqrt{2}}{\sqrt{5}-3}\cdot\frac{\sqrt{5}+3}{\sqrt{5}+3}=\frac{\sqrt{10}+3\sqrt{2}}{5-9}=\frac{\sqrt{10}+3\sqrt{2}}{-4}=\frac{\sqrt{10}-3\sqrt{2}}{4}$

24) $\frac{\sqrt{2a^3b}}{\sqrt{6a}}=\frac{\sqrt{a^2b}}{\sqrt{3}}=\frac{a\sqrt{b}}{\sqrt{3}}\cdot\frac{\sqrt{3}}{\sqrt{3}}=\frac{a\sqrt{3b}}{3}$

25) $\frac{3+\sqrt{5}}{3-\sqrt{5}}\cdot\frac{3+\sqrt{5}}{3+\sqrt{5}}=\frac{9+3\sqrt{5}+3\sqrt{5}+5}{9-5}=\frac{14+6\sqrt{5}}{4}$

$=\frac{7+3\sqrt{5}}{2}$

26) $(2\sqrt{6}+\sqrt{5})(2\sqrt{6}+\sqrt{5})$

$4\sqrt{36}+2\sqrt{30}+2\sqrt{30}+5$

$4\cdot 6+4\sqrt{30}+5$

$24+4\sqrt{30}+5$

$29+4\sqrt{30}$

27) $\frac{\sqrt[3]{48x^7}}{\sqrt[3]{2x}} = \frac{\sqrt[3]{24x^6}}{1} = \sqrt[3]{24x^6}$

$\sqrt[3]{8x^6}\ \sqrt[3]{3}$

$2x^2\sqrt[3]{3}$

28) $\frac{8\sqrt{20x^8} - 4\sqrt{10x^3}}{2\sqrt{5x}} = \frac{\overset{4}{\cancel{8}}\sqrt{\cancel{20}x^8 4x^7}}{\cancel{2}\sqrt{5x}} - \frac{\overset{2}{\cancel{4}}\sqrt{\cancel{10}x^3 2x^2}}{\cancel{2}\sqrt{5x}}$

$= 4\sqrt{4x^7} - 2\sqrt{2x^2}$

$\sqrt{4x^6}\sqrt{x}$ $\quad$ $\sqrt{x^2}\sqrt{2}$

$4 \cdot 2x^3\sqrt{x}$ $\quad$ $-2 \cdot x\sqrt{2}$

$8x^3\sqrt{x} - 2x\sqrt{2}$

29) $4(x+4) = x + 2(x+11)$

$4x + 16 = x + 2x + 22$

$4x + 16 = 3x + 22$

$-3x - 16 \quad -3x - 16$

$x = 6$

30) $3x - 7 = 2 - (2x + 6)$

$3x - 7 = 2 - 2x - 6$

$3x - 7 = -4 - 2x$

$+2x + 7 \quad +7 + 2x$

$\frac{5x}{5} = \frac{3}{5}$ $\quad x = \frac{3}{5}$

31) $14 + 3(x+2) = 3 + 2(x+9)$

$14 + 3x + 6 = 3 + 2x + 18$

$20 + 3x = 21 + 2x$

$-20 \quad -2x \quad -20 \quad -2x$

$x = 1$

Plug into y= then look at the table for the x-values where y is 0.

32) $x^3 - 5x^2 + 4x$ zeros are: $0, 1, 4$

33) $x^4 - 3x^3 - 8x^2 + 12x + 16$ zeros: $-2, -1, 2, 4$

34) $x^4 - 3x^3 - 37x^2 + 27x + 252$ zeros: $-4, -3, 3, 7$